

REMARKS

Claims 24-34 are presented herein for consideration, Claims 1-34 are pending in the application. Claims 22 and 23, which were first presented in the Amendment filed on March 19, 2003, have been withdrawn from consideration.

In view of the following comments, Applicants respectfully request reconsideration and allowance of the claims at issue.

Rejection under 35 U.S.C. §103(a) based on U.S. Patent No. 5,675,648 to Townsend

Page 3 of the Office Action sets forth a rejection of Claims 1-5, 9-15, 17-21 under 35 U.S.C. §103(a) as being unpatentable over the disclosure of U.S. Patent No. 5,675,648 to Townsend. Applicants respectfully traverse this rejection. Independent Claims 1, 11, and 20 are the only independent Claims at issue with respect to this rejection.

Amended Claim 1 is directed to a fiber optic modulator system with, among other features, a first polarization maintaining (PM) coupler for splitting a signal received from the source into a first optical path and a second optical path, the first optical path and the second optical path forming a Mach Zender Modulator. A phase modulator disposed in the first optical path, and a piezo-electric transducer (PZT) is disposed in the second optical path. The modulator system also includes a second PM coupler for recombining the first and second optical paths, and a detector for detecting the output from the second PM coupler. An amplifier is disposed in the first optical path between the phase modulator and the second PM coupler.

Townsend does not disclose a modulator system having an MZM formed of a first optical path and a second optical path, with a phase modulator disposed in the first optical path, an amplifier disposed in the first optical path between the phase modulator and the second PM coupler, and a PZT disposed in the second optical path.

Instead, Townsend discloses a system in which a phase modulator 41 is disposed in one arm of a MZM (Fig. 4), and a fiber coil forms the second arm. The Office Action at page 11 (paragraph 5) observes that Townsend teaches a phase modulator in a first optical path. To the extent that Townsend Fig. 4 may be considered to disclose a first optical path (the lower arm between the two FCs on either side of the modulator 41) and a second optical path (the upper arm of fiber extending between the two FCs on either side of the modulator 41), the two optical paths forming a MZM, Townsend does not disclose a PZT in the second optical path. Nor does Townsend disclose an amplifier arranged between the phase modulator and the second coupler.

Nor does Townsend provide any guidance for modifying the Townsend system to include all of the the features set forth in Claim 1. In particular, nothing in Townsend suggests that an amplifier should be arranged between the modulator 41 and a FC. Nor does Townsend indicate that the fiber between the modulator 41 and the FC to the immediate right of the modulator 41 should be an amplifying fiber. Indeed, Townsend indicates that the security is maintained by "ensuring that the pulses in the transmission fibre contain at most one photon" (col. 4, lines 27-33). Inclusion of an amplifier between the modulator 41 and the right-hand FC would increase the number of photons in the fiber above the single photon level. This modification would tend to render the Townsend device unsuitable for its intended purpose of ensuring that the pulses contain at most one photon to enable the receiver to determine whether eavesdropping is occurring.

For at least these reasons, Claim 1 is patentably distinct over the disclosure of Townsend.

Independent Claim 20 makes clear that a phase modulator is disposed in a first optical path of an MZM and a piezo-electric transducer (PZT) is disposed in a second optical path of the MZM, and that an amplifier is disposed in the first optical path between the phase modulator and the second PM coupler. Accordingly, claim 20 is patentably distinct over Townsend for at least the above-mentioned reasons that Claim 1 is patentably distinct over Townsend et al.

Independent Claim 11 is directed to a method for enhancing the performance of the communication system which has at least one fiber optic modulator, which includes, among other elements, splitting signals from an optical source into first and second optical paths, the first and second paths forming a Mach-Zender Modulator (MZM) cavity, phase modulating the signal in the first optical path, amplifying the phase modulated signal in the first optical path, controlling an optical length of the second optical path, combining the phase modulated signal in the first optical path with the signal in the second optical path; and detecting the combined signals.

Townsend does not disclose at least the feature of controlling an optical path length of a second optical path of a MZM. As discussed above, Townsend discloses using a PZT-based fiber-stretcher in-line with the modulator 41, rather than in a second optical path of the same MZM. For the reasons discussed above, Townsend also does not disclose or suggest amplifying the phase modulated signal in the first optical path of the MZM. Because Townsend

does not disclose or suggest a method having all of the features of independent Claim 11, Claim 11 is patentably distinct over the disclosure of Townsend.

The dependent claims are believed to be allowable for at least the same reasons that Claims 1, 11, and 20 are allowable. Nonetheless, a few comments regarding several of the dependent claims are provided in order to expedite prosecution.

Claim 10 sets forth that a second phase modulator is disposed in the second optical path of the MZM formed by the first and second optical paths, and that a phase modulator and an amplifier are disposed in the first optical path. Applicants note that the Townsend phase modulator 42 is arranged in an entirely different interferometer than is the phase modulator 41 (modulator 41 is in the transmitter 1 and modulator 42 is in the receiver 2). Accordingly, the modulator 41 and 42 cannot correspond to the claimed phase modulators in the first and second optical paths, respectively. Claim 10 is patentably distinct over Townsend for at least this additional reason.

The method of Claim 17 includes phase modulating the signal in the second optical path with a second phase modulator disposed in the second path. Because the modulator 42 is in a different interferometer than the modulator 41, the modulators 41 and 42 of Townsend cannot correspond to the phase modulator in the first optical path and the second phase modulator in the second optical path respectively, the first and second optical paths forming a Mach-Zehnder Modulator cavity, as set forth in Claim 17. Accordingly, Claim 17 is patentably distinct over Townsend for at least this additional reason.

Withdrawal of the rejections of Claims 1-5, 9-15, and 17-21 is therefore respectfully requested.

Rejection under 35 U.S.C. 103(a) based on Townsend and Farina

Claims 6-8, and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over a combination of Townsend and U.S. Patent No. 5,193,128 to Farina. Farina relates to an integrated optic modulator with smooth electro-optic bandpass characteristics. Farina fails to remedy the above-mentioned deficiencies of Townsend. Claim 16 has been amended to address minor informalities, not intended to change the scope of the claim.

Accordingly, Claims 6-8 and 16 are believed to be in condition for allowance. Claims 22 and 23 have been amended to depend from Claim 1, and are believed to be allowable for at least the same reasons that Claim 1 is allowable.

Restriction Requirement

Applicants respectfully request reconsideration of the election of species requirement set forth at page 2 of the Office Action. The Office Action indicates that Claims 22 and 23 each recite that a PZT is disposed in the first PM coupler, that Claim 1 recites that a PZT is disposed in the second coupler, and that the subject matter of Claims 22 and 23 is mutually exclusive of the subject matter in Claim 1. These observations are not entirely consistent with the claim language. Each of Claims 1, 22, and 23 recite that a PZT is disposed in the second optical path of an MZM, and that a phase modulator is disposed in the first optical path. None of Claims 1, 22, and 23 recites that a PZT is disposed in either the first PM coupler or in the first optical path. Accordingly, the Examiner is requested to reconsider the restriction/election requirement and to examine Claims 22 and 23 on their merits.

New Claims

Claims 24-27 are presented to set forth subject matter previously recited in original Claim 9 in claims depending from Claims 11, 20, 22, and 23, respectively. Claims 24-27 are patentably distinct over Townsend for at least the same reasons that Claims 1, 11, 20, 22, and 23 are allowable.

New Claim 28 is presented to set forth some of the subject matter previously recited in Claim 10 in independent form. Claim 28 is directed to a fiber optic modulator system having an optical source, a first polarization maintaining (PM) coupler for splitting a signal received from the source into a first optical path and a second optical path, the first optical path and the second optical path forming a Mach Zehnder Modulator (MZM), a first phase modulator disposed in the first optical path, a piezo-electric transducer (PZT) and a second phase modulator disposed in the second optical path, a second PM coupler for recombining the first and second optical paths, and a detector for detecting the output from the second PM coupler. Townsend does not disclose at least a fiber optic modulator system having a phase modulator disposed in the first optical path and a piezo-electric transducer (PZT) and a phase modulator disposed in the second optical path, the first optical path and the second optical path forming a Mach Zehnder modulator cavity. Townsend discloses a interferometer with a modulator 41 in one arm, but does not disclose a PZT and phase modulator in the other arm of the interferometer. Nor is there any guidance in Townsend that the Townsend interferometer should be modified to include a PZT and phase modulator in the other arm of the interferometer. Claim 28 is patentably distinct over Townsend for at least this reason.

Claims 29-34 are provided to set forth additional subject matter to which the applicants are believed to be entitled.

New claim 29 depends from Claim 11 and sets forth that the optical source transmits an optical signal to the optical coupler, the optical signal transmitted to the optical coupler having an optical power level greater than an optical power damage threshold of the phase modulator. Support for this language is found at least at paragraphs [0001]-[0004] of the specification and the Abstract. At least this feature is not found in Townsend.

New claim 30 sets forth that the phase modulator is a lithium niobate phase modulator, and is allowable for at least the same reasons that Claims 11 and 29 are allowable.

New claim 31 sets forth a method in a fiber optic system having a first optical path and a second optical path, the first and second optical paths forming a Mach-Zender Modulator (MZM) cavity, at least one phase modulator being disposed in the first optical path, the phase modulator having at least one phase modulator having a threshold breakdown level. The method includes providing an optical signal to an optical coupler, the optical signal having an optical power level greater than the threshold breakdown level of the fiber optic modulator; the optical coupler splitting the optical signal into a first optical signal in the first optical path and a second optical signal in the second optical path; phase modulating the first optical signal with the fiber optic modulator; controlling an optical path length of the second optical path; combining the phase modulated first optical signal with the second optical signal; and detecting the combined signals. Townsend does not disclose a method having all of the features of Claim 30, and in particular, does not disclose: providing an optical signal to an optical coupler, the optical signal having an optical power level greater than the threshold breakdown level of the fiber optic modulator; and controlling an optical path length of the second optical path. Claim 31 is believed to be allowable over Townsend for at least these reasons.

Claims 32-34 depend from Claim 1 and are believed to be allowable for at least the same reasons that Claim 1 is allowable.

Favorable action on new claims 24-34 is therefore respectfully requested.

Conclusion

All of the outstanding matters having been addressed, Applicants request an early indication of the allowability of the application, in the form of a Notice of Allowance. Should any questions arise with regard to this submission, or with regard to the application in general, Examiner Kianna is invited to contact the either of the attorneys listed below.

The attached Fee Transmittal Sheet provides authorization to charge the three-month extension fee, the additional claim fee, and the RCE fee to Deposit Account No. 50-0281. Although no additional fee is believed to be due, the Commissioner is authorized to charge any fee which may be due, or credit any overpayments, to Deposit Account No. 50-0281.

Respectfully submitted,



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